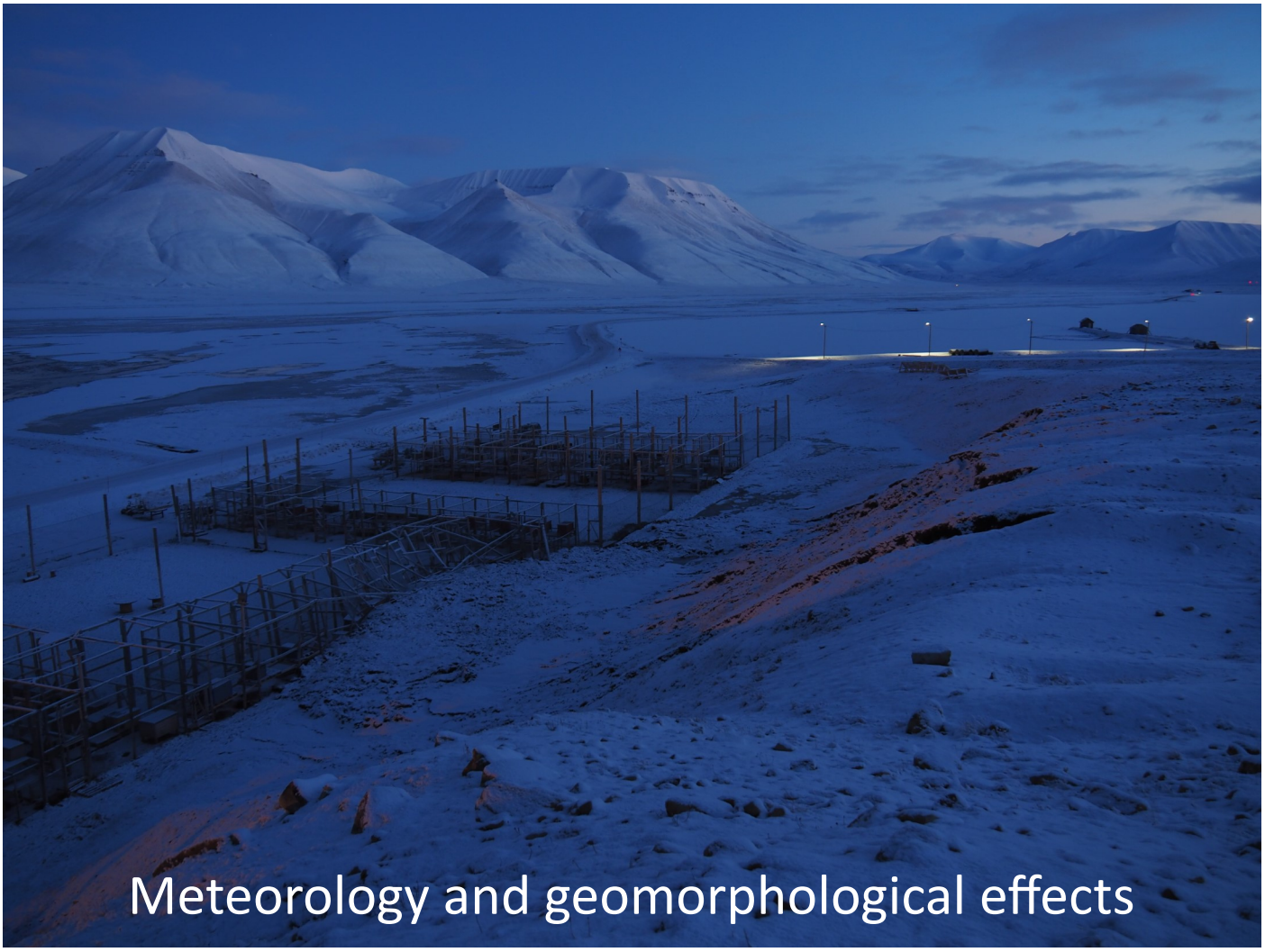
# The 7-8 November 2016 Rainstorm in Longyearbyen, Svalbard

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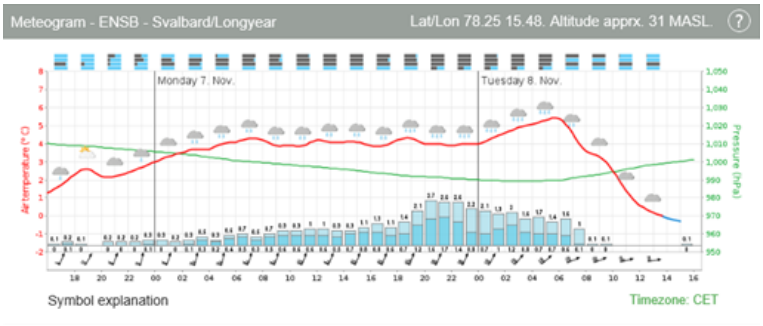
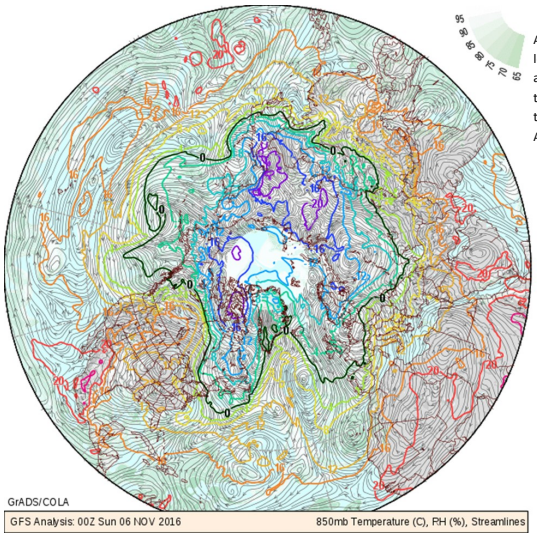
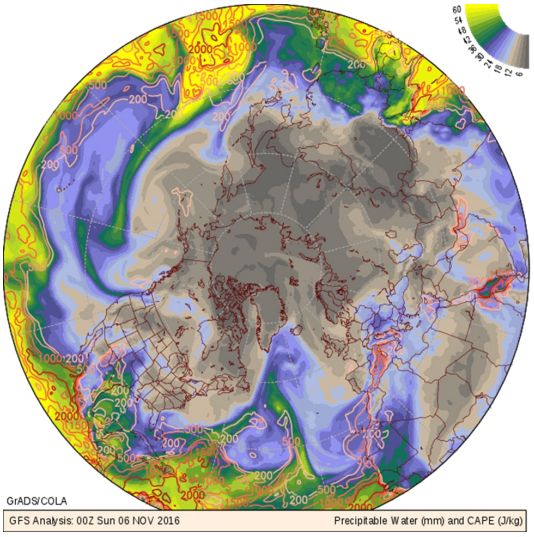
## Meteorological overview




Sunday 6. November 2016: Warm and moist airmasses were moving across the Greenland Sea along East Greenland, heading for Svalbard (diagrams below). The Norwegian Meteorological Institute forecasted stong winds and heavy precipitation for all of Monday, and into Tuesday morning. Air temperatures at sea level were forecasted to increase from about 1.5 to about 5.5°C during this period of time.



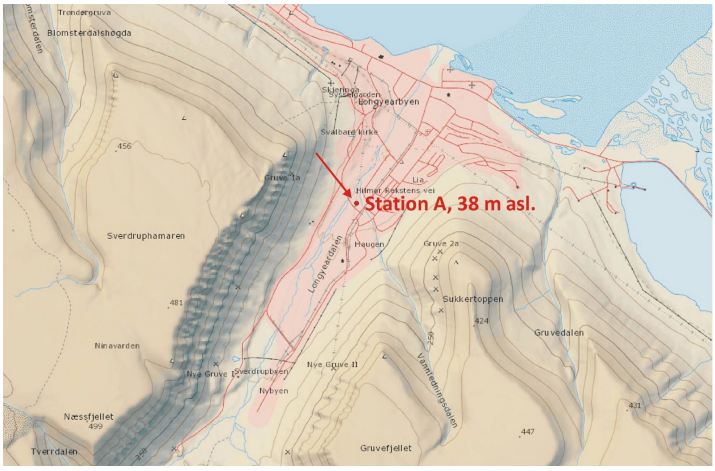

Air movement in lower part of the atmosphere. The thick line indicate the limit of cold Arctic airmasses.



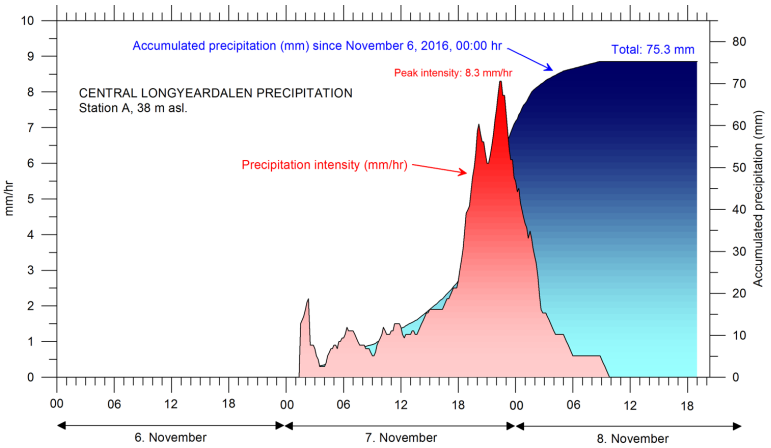

Colors indicate the amount of precipitable water (mm) in the atmosphere.

Monday-Tuesday, 7-8 November 2016:

The rain began shortly after midnight between 6 and 7 November, reaching a peak in the evening of 7 November, but continued until the morning on Tuesday 8 November. A rain gauge installed by UNIS in central Longyeardalen by UNIS, recorded about 75 mm rain (see diagrams to the right). In Longyeardalen, winds were strong from the SW, that is, parallel to the valley axis.

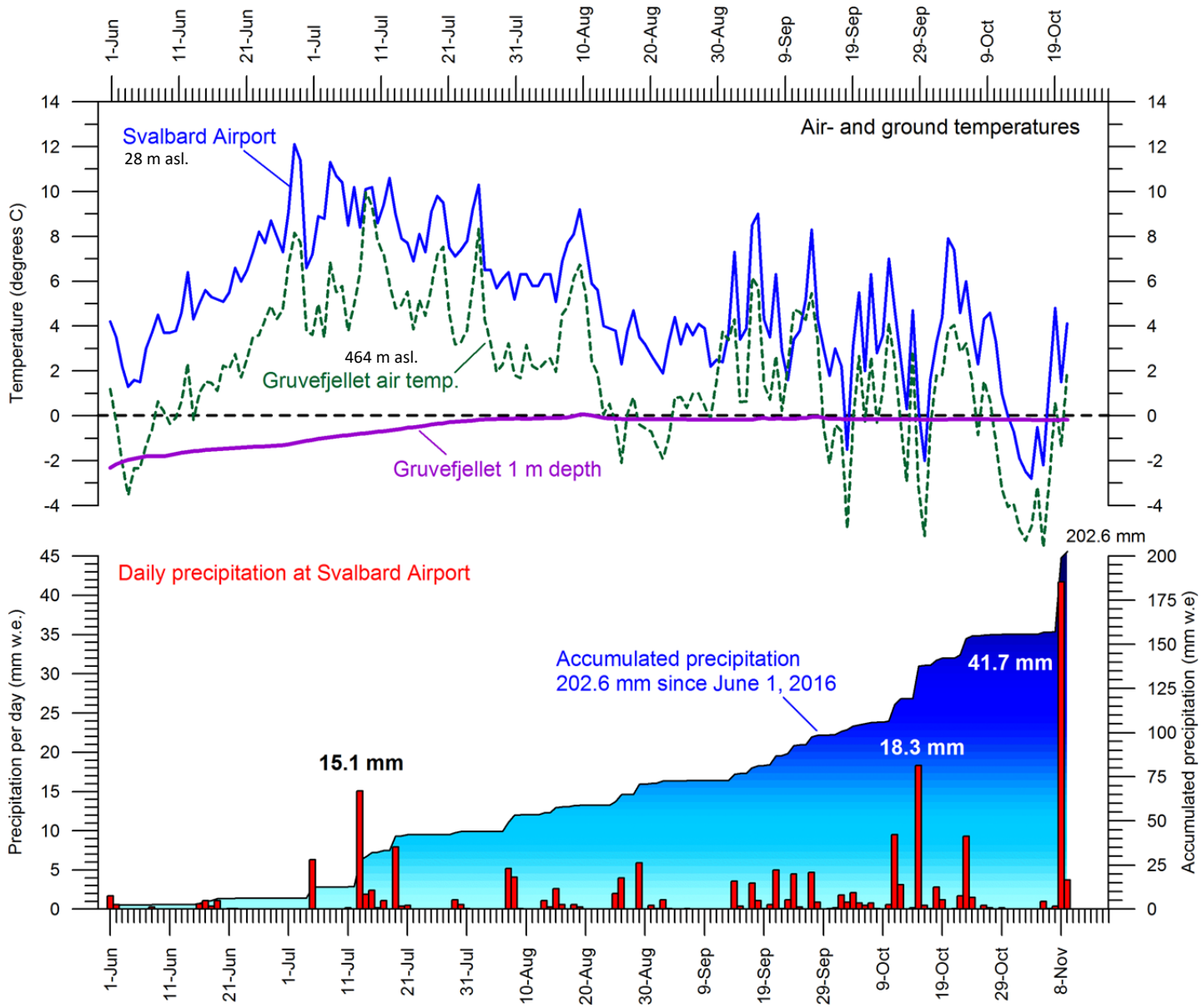



Air temperatures slowly increased during the storm, by which the snowline gradually moved up from about 300 m to about 5-600 m altitude. At higher altitudes, precipitation fell as snow throughout the rainstorm experienced near sea level.




At the end of the rainstorm Tuesday morning, the winds turned towards NW, and air temperature at sea level rapidly fell below freezing. Strong wind and snow showers subsequently dominated the weather the following afternoon.

The diagram on the next page shows key meteorological values recorded by the official meteorological station at Svalbard Airport, and values recorded by UNIS' meteorological station at Gruvefjellet (464 m asl.).




<u>Observed geomorphological effects of the rainstorm below 500 m altitude:</u>

The observed high precipitation during the November 7-8 rainstorm, about 46 mm and 75 mm, at the Airport and in Longyeardalen, respectively, made a high number of new landslides and debris flows highly likely. This assessment was made based on the background of the previous rainstorm 15 October 2016 (about 18 mm rain), where several large and medium-sized slides occurred in the near surroundings of Longyearbyen (see separate UNIS report on this).

Landslides were released during the November rainstorm (see photo to the right), but in a much smaller number and scale than expected. No houses in Longyearbyen were directly affected by slides, and the only damage on property occurred at the kennel shortly outside town, where a active layer detachment slide damaged part of the dog yard (see front cover photo).

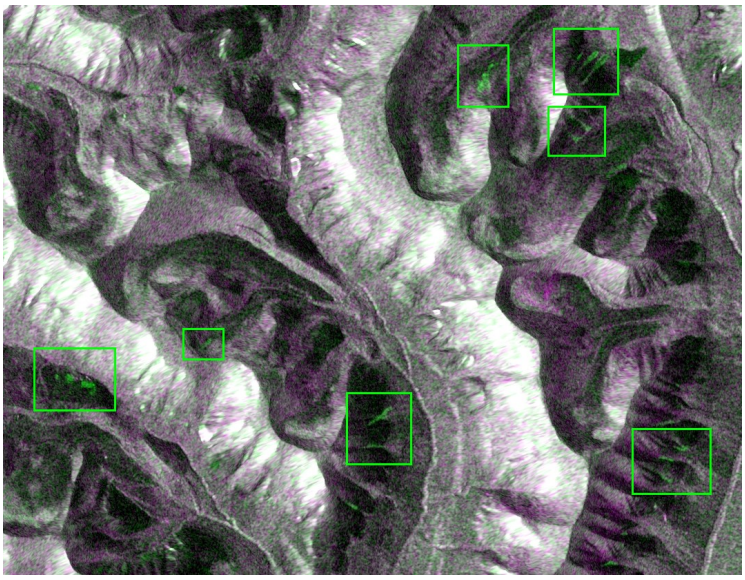
Fresh slides on the eastern slope of Longyeardalen, as seen shortly after the rainstorm

Observed geomorphological effects of the rainstorm above 500 m altitude:

Above 500 m most precipitation fell as snow during the November rainstorm with blizzard-like conditions, and for that reason, the geomorphological effects were different to those observed at lower altitudes.

The predominant result of the precipitation event at high elevations around Longyearbyen was the release of numerous snow avalanches. In the early afternoon of Tuesday 8 November a reconnaissance helicopter flight was carried out by the Governor of Svalbard, to inspect slopes and rivers in Adventdalen and a number of adjoining valleys. During this flight several snow avalanches were observed on slopes above 500 m altitude in Bolterdalen (photo to the upper right) and elsewhere, with orientation downwind in relation to the previous strong SW wind dominating the precipitation event, testifying to strong snow blow by wind across mountain ridges and -plateaus above.

Several of the biggest snow avalanches could be observed on radarsatellite images (see, e.g. https://titan.uio.no/node/2009). Here we show to the right an improved radarsatellite image with even smaller avalanches visible, prepared by Norut.

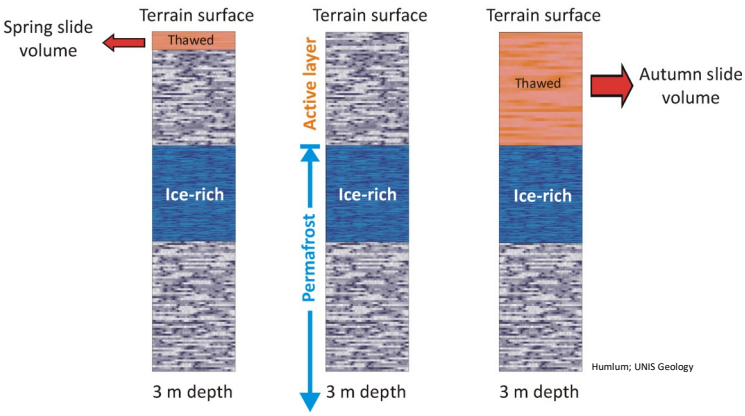


Radarsatellite image by Norut (http://norut.no/en/). Image centred on Tillbergfonna and upper Gangdalen.

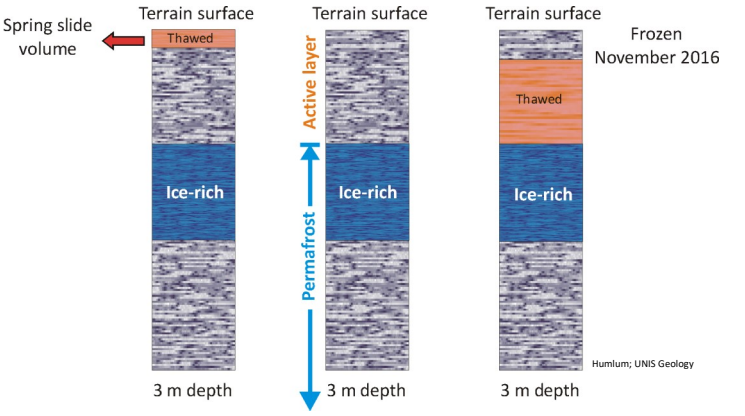
Reflections on why so few landslides were released at low altitudes during the November rainstorm:

Landslides and debris flows may occur at any time outside the winter season. Often, but not always, heavy rain is the triggering factor. In the Spring, debris flows usually are small in volume, as the thawed layer is shallow. In the Fall, however, the thawed layer is thicker and may represent the entire active layer, and debris flow volumes are therefore are often much bigger (see schematic figure to the right). The magnitude of fall slides may also reflect instability at the interface between the active layer and the ice-rich permafrost.

The November rainstorm 2016 was preceded by a period of freezing at all altitudes, also near sea level (see diagram on previous page). Even though the active layer before the rainstorm probably remained thawed to the permafrost below, the uppermost 20-30 cm was frozen (diagram lower right). This frozen layer may have limited the amount of rain percolating into the active layer, at least while thawing of this layer was going on. This illustrates the high importance of monitoring ground temperature dynamics in periods leading up to rainstorms, when attempting to evaluate the degree of danger for release of large landslides during rainstorms in the Longyearbyen area.




Permafrost around longyearbyen is more than 100 m thick most places

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